# Gulf of Mexico Alliance White Paper
# Improving Gulf of Mexico Water Quality

## Problem statement/goal

Coastal areas of the Gulf of Mexico are experiencing a variety of water quality-related problems, including eutrophication, elevated bacteria levels, harmful algal blooms (HABs), hypoxia, and toxic contamination of fish and wildlife. While these problems at present are localized and episodic, their extent and frequency are increasing. Increased growth and human activities in coastal areas that result in additional pollutants and habitat degradation (i.e. wetland loss) affecting coastal waters are significant causes of these problems. One of the goals of the Gulf of Mexico Alliance is to initiate collaborative efforts between the Gulf Coast states and the Federal government to address these problems. The focus of this paper is on identifying actions which could be taken to protect water quality and aquatic life, with a specific emphasis on protecting shellfishing and aquatic recreation. This paper is one of a series of white papers on environmental issues affecting the Gulf Coast States. Other white papers include: (1) reductions in nutrient loading; (2) restoration of coastal wetlands; (3) identification of Gulf habitats to inform management; and (4) Gulf of Mexico environmental education, all of which can effect water quality.

## Background

Pollution problems in coastal areas of the Gulf of Mexico are causing concerns for both public health and aquatic life. Pollution affecting public health includes bacterial and toxic contamination and HABs. Bacterial contamination of streams, bayous, beaches, and shellfish growing areas results in the temporary and sometimes permanent closure of shellfish beds to harvesting for human consumption and the postings of advisories or warnings at contact recreation areas, including bathing beaches. Maintaining healthy beaches in the Gulf States is vital to the economic well-being of the states' tourism industries. Toxic contaminants in tissue have resulted in consumption advisories for some species of fish in coastal areas of the Gulf of Mexico, including king mackerel due to mercury, speckled trout in some bays due to PCBs, and catfish and blue crabs in some bays due to dioxins. HABs, including red tide, have resulted in the issuance of advisories for many coastal areas, episodically halting commercial and recreational shellfish harvesting, limiting recreation, exacerbating respiratory problems, and adversely affecting aquatic life.

Other threats to aquatic life include low dissolved oxygen (DO) levels (hypoxia) and increased turbidity, addition of excess nutrients, pesticides and metals, alteration of freshwater inflows and habitat degradation, all of which can have adverse affects on the aquatic life of coastal waters. Low dissolved oxygen levels can adversely affect aquatic organisms, especially early life stages that are particularly sensitive to low DO levels and benthic organisms that have limited mobility. Elevated turbidity levels can decrease light penetration, adversely affect seagrass beds, smother benthic organisms, and clog fish gills. These changes can result in stressed or altered species composition of aquatic communities. Stressed communities may exhibit such adverse effects as fish lesions (e.g. fish may develop ulcers in response to a myriad of environmental stressors, including infection by the harmful dinoflagellate, *Pfiesteria)*, changes in habitat structure

(including loss), large changes in primary productivity community types, lowered diversity, susceptibility to non indigenous species invasions, and altered community composition.

Point sources remain an important source of pollutants to coastal waters. However, stormwater runoff and atmospheric deposition from the Gulf's watersheds and airsheds have now been recognized as also being major sources of pollutants and have been associated with water quality problems. However, predictive models with the ability to link human activities associated with nonpoint source runoff with environmental responses are lacking. Additionally, the available data to assess problems are primarily limited to nutrients and bacteriological indicators, with limited data from coastal waters for other pollutants frequently found in non-point source runoff, such as pesticides and metals.

**Strengths/Progress**

Federal and State water quality programs and local initiatives have established a fundamental framework for water quality management. This framework includes the United States Environmental Protection Agency (USEPA) coordinating with state agencies based on the State surface Water Classification of waters for propagation of shellfish and aquatic organisms, the National Pollution discharge Elimination System (NPDES) for permitting of wastewater and stormwater discharges, Total Maximum Daily Load (TMDL) programs to address impairments, and water quality monitoring and assessment networks for coastal waters. Other programs have been implemented to prohibit waste and ballast water discharges from cruise ships and smaller vessels and live-aboards, create national estuary programs, and to create a variety of funding mechanisms, such as SeaGrant, for major research programs and local coastal improvement efforts. In addition, habitat protection and mitigation efforts are underway in Gulf States to help address coastal wetland loss and submerged aquatic vegetation decline.

Gulf Coast States have participated in comprehensive programs to evaluate shellfish beds and beaches. For example, Florida's Shellfish Environmental Assessment Section (SEAS) program has been in existence since the 1940s. The SEAS program has established models to predict the potential for adverse human health effects usually based on fecal pollution resulting from various rainfall levels, river levels, and times of the year (seasons).

The Gulf Coast states also currently implement the provisions of the National Shellfish Sanitation Program (NSSP). The NSSP is modified by the Interstate Shellfish Sanitation Conference (ISSC). The ISSC is composed of Federal agencies (U.S. Food and Drug Administration, U.S. National Marine Fisheries Service, and USEPA), State health and resource agencies, the shellfish industries, and academia. This partnership is working well to define the conditions for safe molluscan shellfish consumption.

There has been considerable collaboration among the Gulf States on HAB monitoring and response. Gulf States have collaborated with the federal government in creating the HABSOS (the HAB Observing System). The USEPA has funded monitoring for *Pfiesteria* in the Gulf States, which has enhanced the understanding of the distribution of this potentially harmful dinoflagellate in the Gulf. In a similar manner, states and universities around the Gulf have joined efforts recently to form the Gulf coast Ocean Observing System (GCOOS). GCOOS is

focused on building an integrated network of real-time, in situ monitors in the Gulf, which will improve our understanding of water quality and circulation patterns in the open Gulf.

The Federal BEACH Act provides money through USEPA to the states to conduct beach bacteria monitoring and public notification of potentially unhealthy conditions, with thousands of miles sampled weekly or biweekly. This information is submitted by the states to the USEPA, who review the data to ensure uniformity, and compile the data into a database. This information can be viewed at www.epa.gov/ost/beaches. Gulf States have invested considerable funds over recent years in studying sources of bacteria in the water.

The Gulf of Mexico Program has connections to seven National Estuary Programs (NEPs in the Gulf region, with established networks of local partners implementing water quality related initiatives.

**Challenges/Barriers**

There are a number of challenges in addressing these problems.

In some cases (e.g. DO levels), there is a need for sufficient diel DO data to develop a more complete understanding of the degree and spatial extent of localized problems, and in order to develop more appropriate estuarine DO criteria. While considerable monitoring using a probabilistic approach has taken place over the past 5 years through the National Coastal Assessment (NCA) Program for some parameters (e.g. metals, pesticides), there is still insufficient information currently available to assess whether there are problems resulting from these pollutants. To better address bacterial contamination, there is a need for better tracking tools so that specific sources can be identified and addressed, and for better understanding of the relationship between various sources of bacterial contamination (humans, birds, animals) and the potential for human illness during recreation. There is also a need to develop more appropriate water quality standards for assessing ecological health (e.g., what are the "true" background conditions), which should include biological indicators of impairment.

The coastal areas are the most rapidly developing regions of the five Gulf Coast states. As a long-term goal, there is a need for tools to better understand the relationship between whole watershed land uses and the resulting water quality problems. A critical need to facilitate this understanding is the establishment of long-term monitoring of changes in land cover and land use for coastal watersheds. A better understanding of these relationships will allow the development of best management practices to achieve the necessary reduction in pollutants from nonpoint sources. Comprehensive land use planning and day-to-day planning and zoning decisions can directly impact water quality. Likewise, regional, state and federal land use planning and decisions also can directly impact water quality. A better understanding of the relationship between land uses and the resulting water quality problems will allow local, regional, state and federal decision-makers to factor in these potential adverse effects when land use decisions are made.

Coastal erosion, wetland loss, and hydrologic changes to coastal aquatic systems also affect water quality. A major challenge is considering the cumulative impacts of the increasing coastal

populations, with the associated habitat loss, hydrologic alteration, and alteration of freshwater inflows on water quality of coastal ecosystems (e.g. loss of wetlands results in the loss of water quality filtering in coastal waters, industries, deep water ports, increased freshwater usage and the increased commercial and recreational use of coastal waters all cumulatively affect water quality)..

**Opportunities/Potential Solutions/Priorities**

Since Gulf Coast states are facing similar water quality problems, there is an opportunity to develop a collaborative approach between the Gulf Coast states, local governments, and the Federal government to address these issues. A better understanding of potential water quality effects of the increasing coastal population densities and the resulting land use changes is needed to protect existing aquatic life and shellfish resources and to reduce potential effects on human health associated with water-based activities.

Some areas along the Gulf coast have comprehensive conservation management plans (CCMPs), developed by the NEPs in the region. There are opportunities to Enhance partnerships with the NEPs to implement the CCMPs in general, but specifically to test and implement stormwater management practices, address failing septic systems, and enhance habitat conservation efforts in areas under the greatest pressure of conversion to non-sustainable uses.

Specific recommendations for the development of tools to address water quality problems include:

- A comprehensive water quality monitoring program should typically consists of collecting bacteria, dissolved oxygen, pH, turbidity, salinity, organic chemicals, metals, and other conventional water chemistry parameters, which are needed to help develop better tools to protect coastal water quality. Given the relatively limited amount of available data for coastal waters, we recommend that USEPA provide funding to continue and improve State monitoring of coastal waters. Through the NCA program, USEPA provided funding to the Gulf states for an initial sampling of coastal waters using a probabilistic approach, and USDA funded a limited study on water monitoring of shellfish farms using real time sensors, and NOAA has provided funds for several investigations in water quality in the coastal zone. Continuation of these types of monitoring is needed. In addition, information generated from these programs needs to be used to develop guidance for coastal development activities and guidance to local, state, regional, and federal requirements and decision making for coastal development. There is a need to monitor water quality more intensively in small tidal streams. These tidal streams provide critical habitat along extensive portions of the Gulf coast not fed by major rivers. These streams also provide considerable recreational benefit, both for swimming, boating and fishing for local communities, yet they are one of the least understood of our coastal ecosystems. Finally, federal partners should work with the Gulf States to refine water quality criteria specific to southern coastal waters, especially for DO and biological indicators.
- Tools to relate land use activities and habitat degradation/loss to water quality problems – Landscape models are needed with the ability to integrate the type and intensity of human

land uses, effectiveness of Best Management Practices, flow paths, and the prediction of the pollutant loadings and ultimate degradation of Gulf coastal and estuarine systems. GIS tool development should be coordinated between state, federal and academic programs. These tools need the support of a long-term coastal land use/land cover monitoring system that would illustrate changes in land use and land cover at five year intervals or less.

- Bacterial source tracking (BST) methods – These would help Gulf Coast states better address beach and shellfish contamination problems. *Enterococci* bacteria are indicators of fecal contamination and are found in human, avian, ruminant, and other animal fecal matter. While scientists are developing methods to identify the source of the contamination, more work in this area to develop reproducible, quantitative and inexpensive tests will help environmental agencies correct anthropogenic problems (e.g. leaking sewers). Further, if the risk of human illness from exposure to different animal wastes while swimming is known, state officials may issue appropriate warnings about swimming risks rather than provide Beach advisories regardless of the source of the *Enterococci*. Several studies, focusing on bacterial sensitivity to antibiotics, bacterial genetic make-up, and other indicators of human effluent, such as optical brighteners are underway to better predict human sources of bacteria and identify the controllable sources. Additional collaboration with other states would speed up the progress. There is also an opportunity for the federal government to provide assistance to the states (e.g. through the USEPA Office of Research and Development) to improve indicators and develop reliable and rapid BST tools and in establishing specific recreational criteria for different sources of the bacteria and by possibly allowing Beach Act monies to be utilized in BST efforts.
- Biological assessment tools – Ultimately, water quality standards are enacted to protect aquatic life and human health. USEPA has long encouraged States to develop techniques to more accurately evaluate the biological integrity of the Nation's waters. While many states have bioassessment tools for streams and lakes, the development of scientifically defensible estuarine biological indicators continues to require considerable effort (data collection, statistical analyses, and interpretation) before they will be legally defensible. Bioassessment tools are needed for determining natural conditions, the locations of degraded communities, and the success of our current pollution control efforts. This should include repetitive biological surveys, especially of benthic organisms.
- Methods to detect, identify the cause of, and limit HABs – Red tide and other HABs regularly impact the waters around the Gulf Coast states. Each bloom event results in beach evacuations, shellfish harvesting area closures and environmental conditions that can be detrimental to aquatic life and human health. Monitoring HABs is still accomplished using methods developed long ago. There is a current need to obtain, test and validate new methodologies to monitor HABs, study their biology and then try to reduce their effects.
- Monitoring of mercury and other toxics in estuarine and marine fish – It is known that several species of estuarine and marine fish have locally unacceptably high mercury body burdens; however, the data may be of insufficient quality, quantity and spatial extent to fully protect public health.

**Needs from State/Federal Partnership**

- Assistance in developing modeling tools to relate watershed wide land use activities to water quality problems, particularly for nonpoint source control. EPA's Office of Research and Development, Ecological Research Program has some prototype models worth expanding to incorporate estuarine issues.
- Concentrated effort to develop and standardize bacterial source tracking methods to ensure accurate, reproducible data for identifying impairment and source contribution ratios, establishing TMDLs, and correcting problems.
- Collaboration and assistance in biological assessment tool development, including identification of indicator organisms. Pooling resources and expertise from EPA, NOAA, and other Gulf states could significantly "jump-start" this effort.
- Epidemiological studies focused on fecal contamination in recreation waters. Research on the relative illness risks from different sources (species other than human) of feces. Improved indicators of bacterial pollution.
- A continuing effort to address sources of toxic contamination in Gulf and estuarine fish species from local and non-local sources.
- Addressing the human causes of harmful algal blooms. If humans are responsible for increasing the frequency of HABs, we would then be able to implement corrective actions.
- Coordination among Federal and State partners in the collection of data to prevent duplication of effort and promote standardization and comparability of methods and data. This should include compilation of data into a Gulf of Mexico database, with web access to increase data and information sharing and facilitate the generation of reports by Federal and State entities. A fundamental need for an effective state-federal partnership to deal with water quality issues is federal funding for regular meetings of Gulf States and federal agencies at least twice per year (e.g. Gulf States fisheries Commission meetings).